Contribution ID: **100** Type: **Oral**

PERFORMANCE OF THE CMS REGIONAL CALORIMETER TRIGGER

Wednesday, 23 September 2009 11:25 (25 minutes)

The CMS Regional Calorimeter Trigger (RCT) receives 8 bit energies and a data quality bit from the HCAL and ECAL Trigger Primitive Generators (TPGs) and sends it to the Global Calorimeter Trigger (GCT) after processing. The RCT hardware consists of 1 clock distribution crate and 18 double-sided crates containing custom boards, ASICs, and backplanes. The electronics for the RCT have been fully installed since 2007.

The RCT has been fully integrated into the CMS Level-1 Trigger chain. Regular runs, triggering on cosmic rays, prepare the CMS detector for the restart of the LHC. During this running, the RCT control is handled centrally by CMS Run Control and Monitor System communicating with the Trigger Supervisor. Online Data Quality Monitoring (DQM) evaluates the performance of the RCT during these runs. Offline DQM allows more detailed studies, including trigger efficiencies. These and other results from cosmic-ray data taking with the RCT will be presented.

Summary

The Regional Calorimeter Trigger (RCT) has been installed in the Compact Muon Solenoid (CMS) cavern since 2007. The custom hardware of the RCT consists of one 6U clock distribution crate and eighteen 9U double-sided crates containing a backplane and boards with custom ASICs. Including spares, almost 1800 boards of 9 different types have been produced. Included are a Clock Input Card, two Clock Fan-out Cards, backplane, Clock and Control Card, Receiver Mezzanine Card, Receiver Card, Electron Identification Card, and Jet/Summary Card. This system receives 8000 calorimeter trigger tower transverse energies (ETs) and characterization bits from the Electromagnetic and Hadronic Calorimeter Trigger Primitive Generators (TPGs) via 4 GBaud copper links. These individual tower ETs and characterization bits are used to find electron candidates and tower ETs are summed over 4x4 regions. They are forwarded to the Global Calorimeter Trigger (GCT) via their source cards for jet finding, missing ET, total ET, and further sorting. The RCT has been fully integrated into the CMS Level-1 Trigger chain using patterns generated in the hardware and by joining in data taking triggering on cosmic-ray muons.

Generating patterns in the RCT and then capturing them in the GCT source cards test the RCT to GCT connection. Both TPG subsystems are also able to generate patterns. These test the TPG serial links to the RCT as well as connections downstream. TPG Patterns are also captured at the GCT. The Global Trigger is included for control and synchronization of all the subsystems involved. These tests are used to verify the connections are sound, especially after a hardware intervention.

The focus of the past year has been on running the CMS detector, triggering on cosmic rays, to prepare for the restart of the LHC. The RCT, as part of the fully integrated calorimeter trigger has actively participated. During this running, the RCT control is handled centrally by CMS Run Control and Monitor System communicating with the Trigger Supervisor. This includes configuration of the RCT and monitoring of these configuration parameters and hardware status bits, including errors.

Online Data Quality Monitoring (DQM) evaluates the performance of the RCT hardware during these runs. In real time, data from the run is collected and compared to reference plots, using the software Trigger Emulator to compare algorithms implemented in the hardware with expected performance. Shift crews and experts monitor the histograms and can rapidly find problems that may be affecting the current run. Then, as soon as runs are completed, Offline DQM is run and the results analyzed. Offline DQM allows for the full event sample to be studied for detailed studies, including as channel-by-channel comparisons and efficiency curves.

In addition, further performance studies are under way to determine overall trigger efficiencies for the various calorimeter trigger types (jet and e/gamma, for example) during the cosmic-ray data taking –details of how these are measured and the overall performance of the RCT during cosmic-ray data taking will be presented.

Primary author: Mrs KLABBERS, Pamela Renee (University of Wisconsin-Madison)

Co-authors: SAVIN, Alexander (University of Wisconsin-Madison); LAZARIDIS, Christos (University of Wisconsin-Madison); LEONARD, Jessica (University of Wisconsin-Madison); EFRON, Jonathan (University of Wisconsin-Madison); GROGG, Kira (University of Wisconsin-Madison); WEINBERG, Marc (University of Wisconsin--Madison); BACHTIS, Michalis (University of Wisconsin-Madison); GROTHE, Monika (University of Wisconsin--Madison); DASU, Sridhara (University of Wisconsin-Madison); GORSKI, Thomas (University of Wisconsin-Madison); SMITH, Wesley (University of Wisconsin-Madison)

Presenter: Mrs KLABBERS, Pamela Renee (University of Wisconsin-Madison)

Session Classification: Parallel Session A3 - Trigger

Track Classification: Trigger